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(54) Title: POLYCRYSTALLINE DIAMOND TOOLS AND METHOD OF MAKING THEREOF

(57) Abstract: The present invention is a tool insert. The tool insert includes a abrasive layer and a substrate. The abrasive layer has a periphery forming a cutting surface and is located on the substrate. The abrasive layer includes at least one of polycrystalline diamond or cubic boron nitride. The abrasive layer tool insert has a sum value of an impact resistance number and an abrasion resistance number that is  $\geq 19,000$ . The impact resistance number is equal to a total number of hits before failure of the tool insert. The abrasion resistance number is equal to equation (1) (1) abrasion resistance = final volume of granite removed by the tool insert (inch<sup>3</sup>)/final tool wear land area (inch<sup>2</sup>) .

## INTERNATIONAL SEARCH REPORT

International Application No  
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A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 C09K3/14 E21B10/56 B23B27/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, COMPENDEX, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 855 996 A (CORRIGAN FRANCIS RAYMOND ET AL) 5 January 1999 (1999-01-05) cited in the application whole document, in particular the examples and figs.1a-c, claim 1	1-21
X	EP 0 352 811 A (NORTON CO) 31 January 1990 (1990-01-31) whole document, but in particular, p. 6, 1.10-15 and 1.24-33, and example 8	1-21
X	US 4 604 106 A (HALL DAVID R) 5 August 1986 (1986-08-05) whole document, but in particular the examples	1-7
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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 096 465 A (CHEN SY-HWA ET AL) 17 March 1992 (1992-03-17) column 4, line 44 - line 65; claims 11-16; example 3 column 7, line 35 - line 64 -----	1-7, 12-14
P, X	WO 2004/000543 A (PHOENIX CRYSTAL CORP) 31 December 2003 (2003-12-31)  whole document, in particular examples and figure 4 -----	1-7, 9-14, 16-21
P, X	WO 2004/031425 A (GEN ELECTRIC) 15 April 2004 (2004-04-15) the whole document -----	1-7

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

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Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 5855996	A	05-01-1999	DE	69626759 D1	24-04-2003
			DE	69626759 T2	04-12-2003
			EP	0779129 A2	18-06-1997
			ES	2194963 T3	01-12-2003
			JP	9254039 A	30-09-1997
			US	6132675 A	17-10-2000
EP 0352811	A	31-01-1990	US	5151107 A	29-09-1992
			US	5011514 A	30-04-1991
			CN	1040164 A	07-03-1990
			EP	0352811 A1	31-01-1990
			JP	2160429 A	20-06-1990
			NO	893081 A	30-01-1990
			ZA	8905783 A	25-04-1990
US 4604106	A	05-08-1986	US	4525178 A	25-06-1985
			CN	86103664 A	04-02-1987
			JP	2594785 B2	26-03-1997
			JP	62041778 A	23-02-1987
			US	4694918 A	22-09-1987
			ZA	8602903 A	25-11-1987
			AT	57484 T	15-11-1990
			DE	3580130 D1	22-11-1990
			EP	0169081 A2	22-01-1986
			IE	58767 B1	03-11-1993
			JP	1769535 C	30-06-1993
			JP	4056790 B	09-09-1992
			JP	61021974 A	30-01-1986
			US	4729440 A	08-03-1988
			ZA	8502536 A	29-01-1986
US 5096465	A	17-03-1992		NONE	
WO 2004000543	A	31-12-2003	WO	2004000543 A1	31-12-2003
WO 2004031425	A	15-04-2004	US	2004062928 A1	01-04-2004
			WO	2004031425 A1	15-04-2004